Evaluation of a Survey Design to Estimate Occupancy and Productivity of Bald Eagle Nests in Kenai Fjords National Park

Bill Thompson

USFWS – Refuges, Northeast Region

Laura Phillips

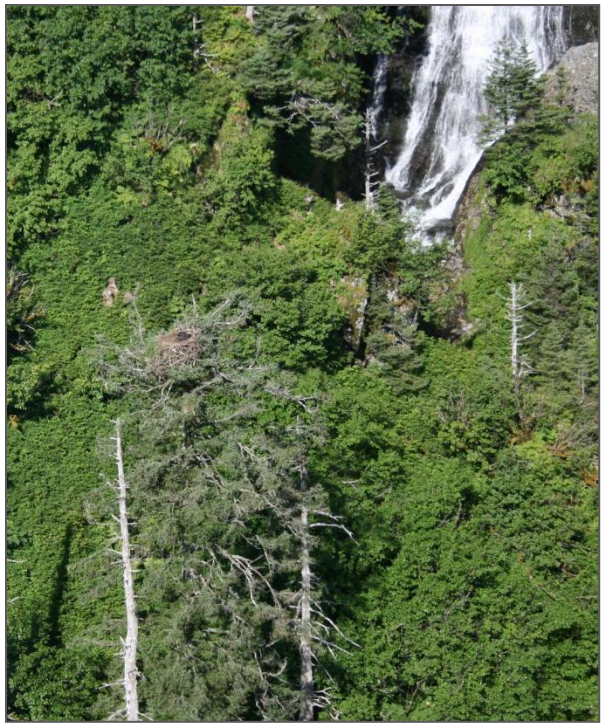
NPS – Kenai Fjords National Park

Goal

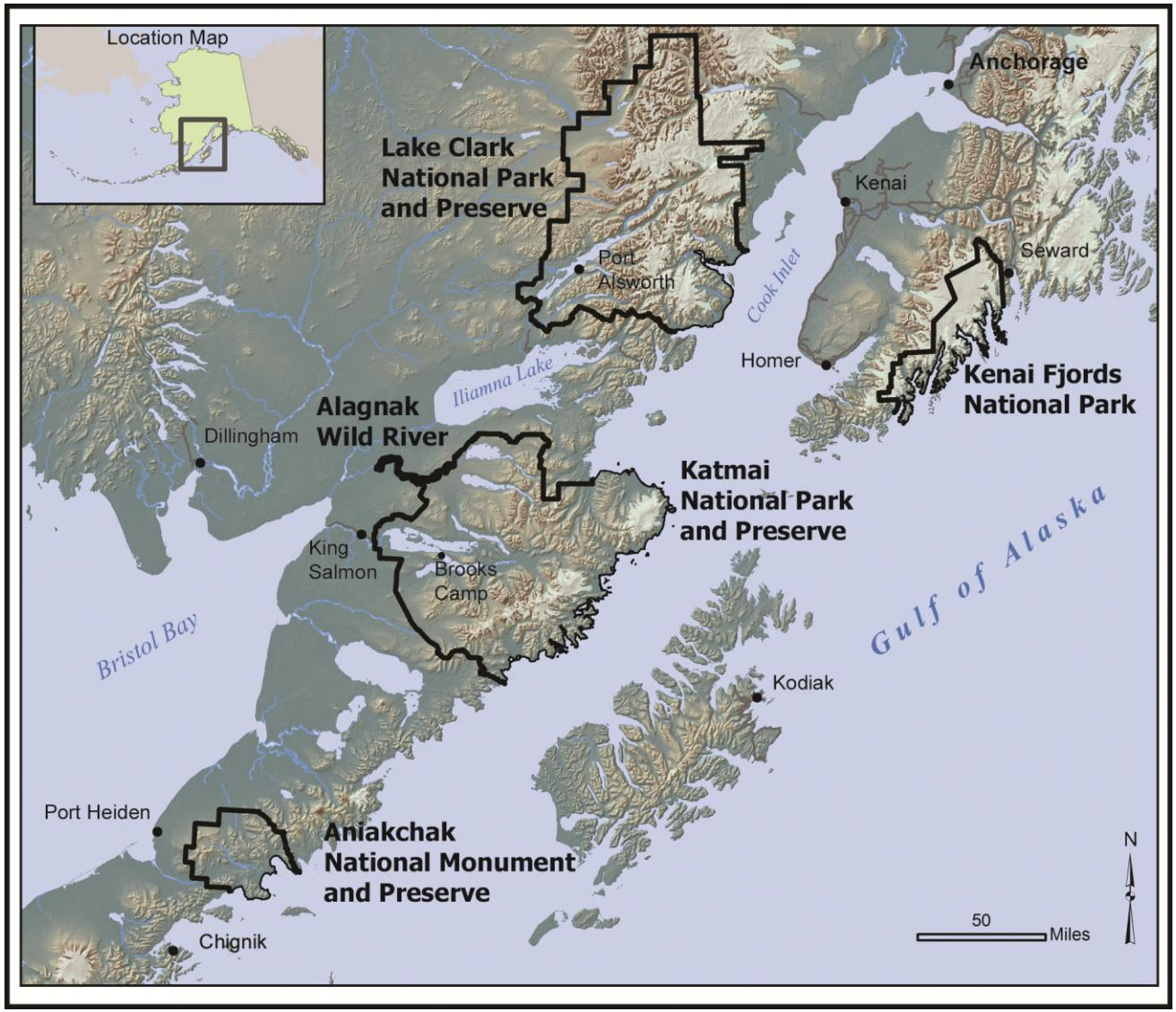
- Monitor Bald Eagle populations as a vital sign of ecological health in SWAN parks
  - Occurrence and reproductive performance influenced by weather, food availability, human-related impacts, and climate.
  - Nest occupancy and productivity indicators of current and long-term change in freshwater and coastal systems
  - Katmai, Kenai Fjords and Lake Clark contain large breeding populations

Objectives

- Develop protocol for monitoring number of occupied nests and nest productivity of Bald Eagles in Kenai Fjords National Park
- Evaluate use of US Fish & Wildlife Service's proposed dual-frame design
  - List frame (list of known nest locations)
  - Area frame (mapping of spatial units [e.g., plots])
  - Double-observer method to adjust for missed nests



Study Area


Location Map
Lake Clark
National Park
and Preserve
Anchorage
Kenai
Seward
Port
Alsworth
Cook Inlet
Homer
Kenai Fjords
National Park
Iliamna Lake
Alagnak
Wild River
Dillingham
Katmai
National Park
and Preserve
King
Salmon
Brooks
Camp
Bristol Bay
Gulf of Alaska
Kodiak
Port Heiden
Aniakchak
National Monument
and Preserve
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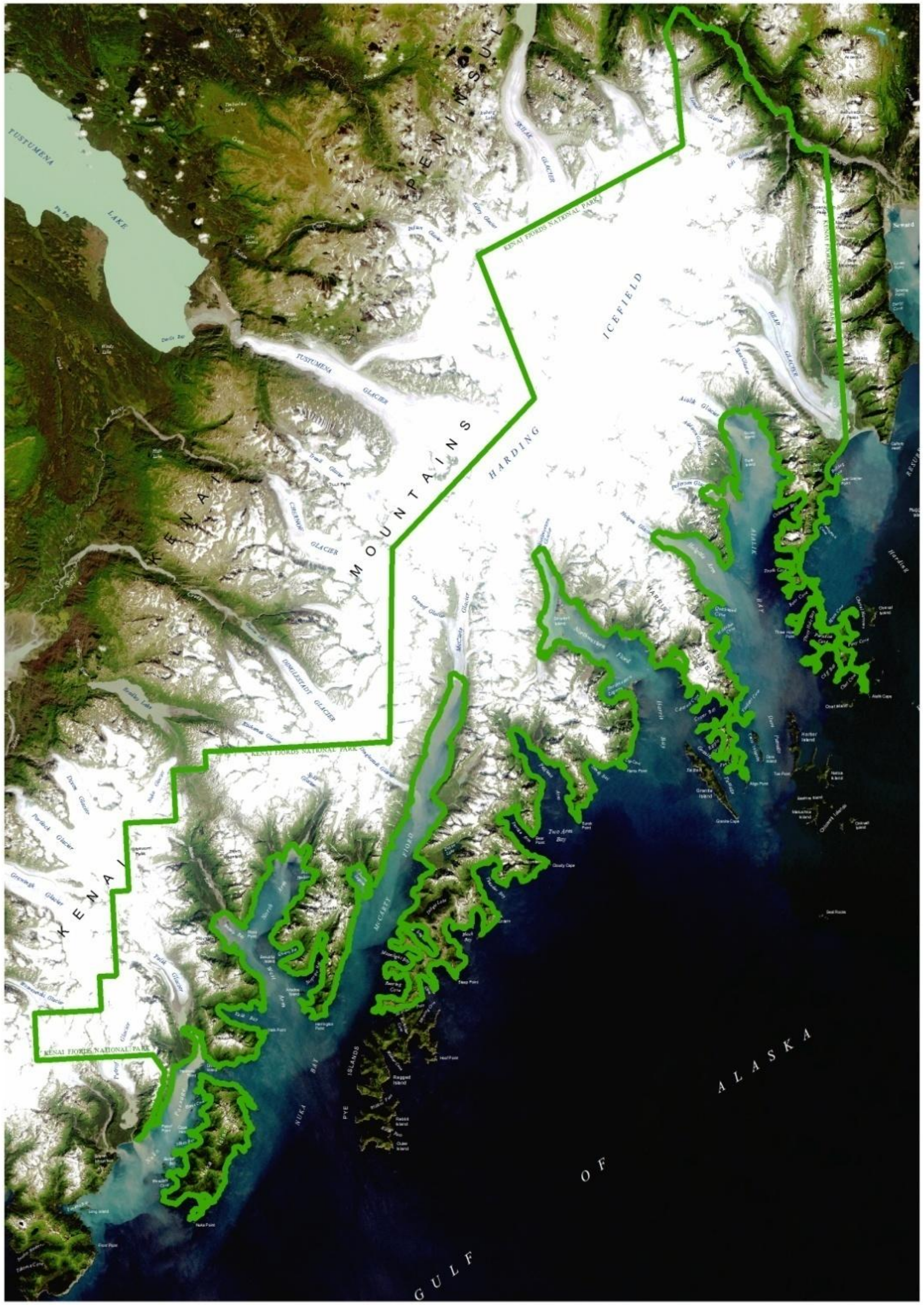


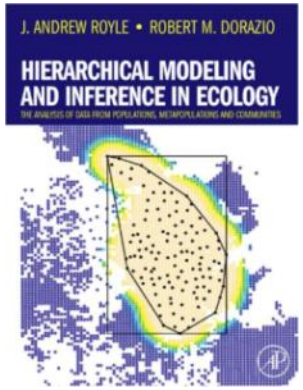
TUSTUMENA LAKE
TUSTUMENA GLACIER
KENAI MOUNTAINS
PENINSULA
HARDING ICEFIELD
KENAI FJORDS NATIONAL PARK
NUKA BAY
PYE ISLANDS
GULF OF ALASKA

Protocol Development – 2009

- Perform spring nest occupancy survey of entire coastline
  - Update list of nests (7 yrs old)
  - Assess costs, logistics
  - Field test double-observer approach
  - Generate estimate of occupied nests
- Double-observer approach
  - Front- and rear-seat observers, independent observations
  - Mark-recapture (Lincoln-Petersen) estimator
  - Encounter history for each newly detected nest (10, 01, 11)

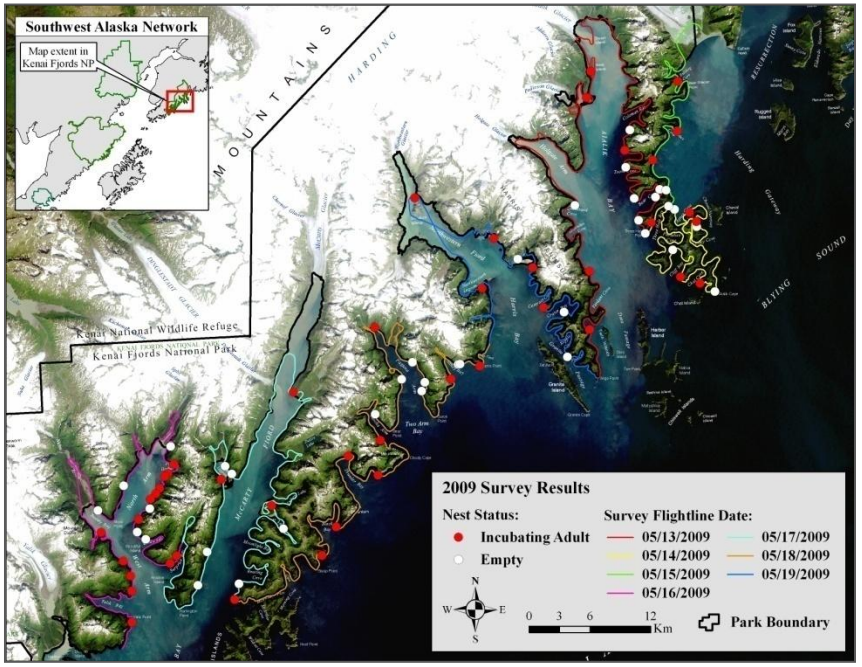
Protocol Development – 2009

- Analysis: Bayesian hierarchical model with data augmentation (00 data)
  - Fit double-observer data and covariates affecting nest detection
    - Time of day
    - Position in tree
  - Assess model fit and convergence
  - Use DIC selection criterion to choose among candidate models
  - Freeware program R, R2WinBUGS library
- Surveyed entire coastline, no need to extrapolate results



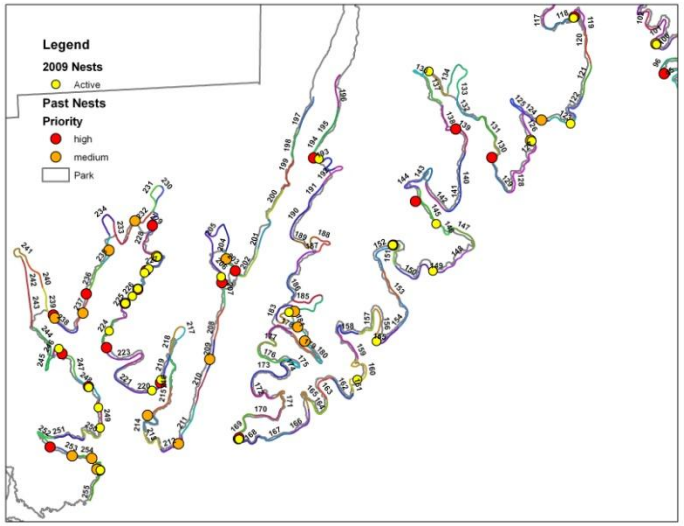
Results – 2009

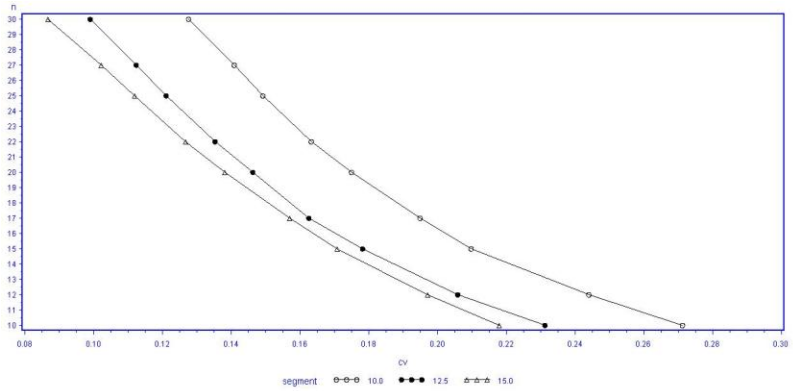
- 39.2 hours FT over 7 days; >500mi coastline
- Detected 44 occupied, 36 empty nests
- 75% occupied nests ≤ 20m shoreline
- Best-supported model
  - Included time of day covariate
  - Estimated 65 occupied nests (95% CI:50, 101)
  - Detection probability: 0.54 front, 0.29 rear



Protocol Development – 2010

- Establish sampling area
- Pre-survey simulations
  - Subdivided Yr 1 flight path into 2.5-km segments
  - “True” population of 65 nests (Yr 1) = 44 obs. + 21 historical
  - Spatially balanced random sampling design (GRTS)
  - Assess optimal size (10 km, 12.5 km, 15 km) and number of sample units to survey (CV<=12%)



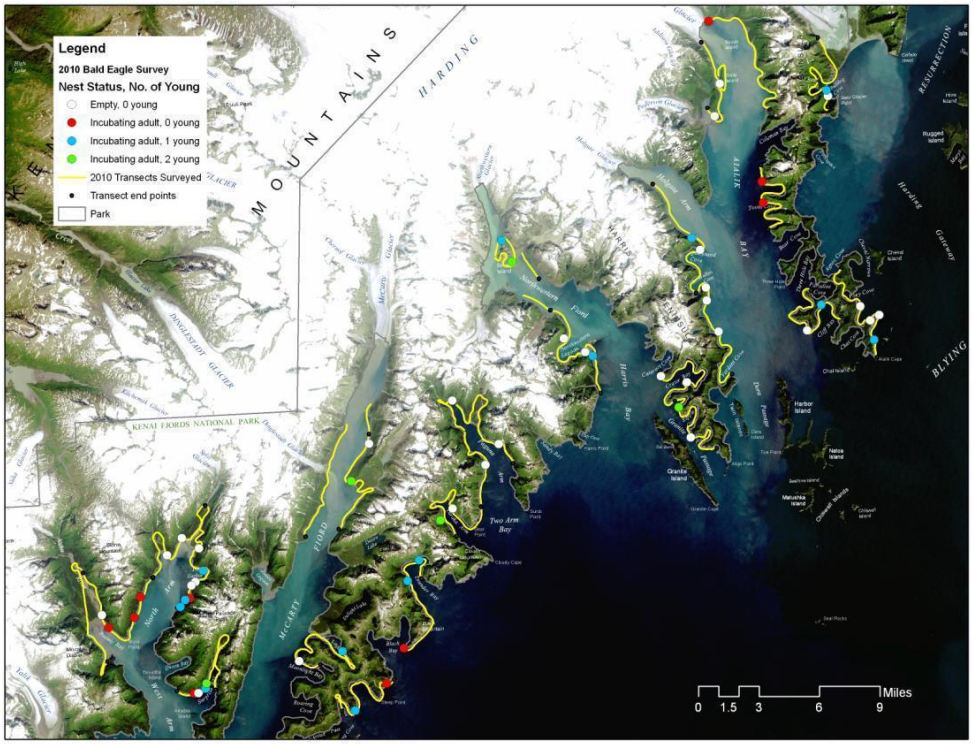


Protocol Development – 2010

- Analysis
  - Evaluate usefulness of dual frame estimator
  - Bayesian hierarchical model to estimate detection probability
    - Uses previous data
  - Estimate occupancy and productivity of nests

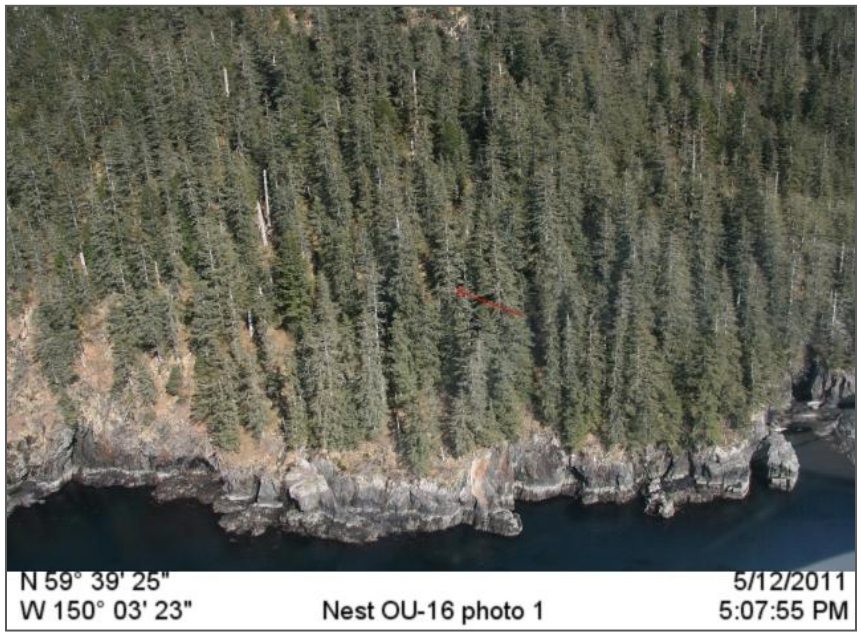
Results – 2010

- Surveyed 25, 12.5km segments
- 18 hours FT over 4 days; 396mi coastline
- Detected 29 occupied nests, 14 new
- Detection probability: 0.33 front, 0.10 rear
- 19 (66%) occupied nests produced ≥ 1 chick
- Estimated 53 fledglings (95% CI: 28-96)



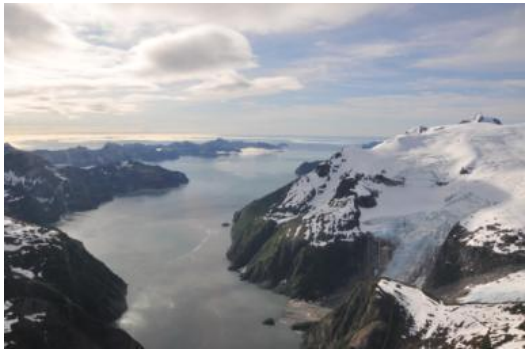
Discussion

- Sampling design feasible given current resources
- Biased estimator for detection probabilities can inflate estimate of occupied nests
  - Careful use of priors
- Importance of good pilot
- Decay of list frame
  - Alternatives to dual-frame
- Defining occupancy, calculating productivity
  - Region-wide comparisons



Protocol Development – Next Steps

- Use area frame design but with Bayesian modeling
  - Known nests, probability of detection = 1
  - Known and new nests in single modeling framework
  - Known nests in sample units updated each survey
- Spatially explicit model
  - Measure of spatial adjacency
  - Estimates for each park subarea (e.g., fjord or bay)
- Simulations to evaluate survey frequency using 2009 - 2012 data



Acknowledgments

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